

New species of Korean *Amyntas* Kinberg, 1867 (Oligochaeta, Megascolecidae) with two pairs of spermathecae

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New species of Korean *Amyntas* Kinberg, 1867 (Oligochaeta, Megascolecidae) with two pairs of spermathecae.- Twenty new species of the genus *Amyntas* are recorded from Korea: *Amyntas piagolensis* sp. n., *Amyntas taebaekensis* sp. n., *Amyntas bubonis* sp. n., *Amyntas vicinus* sp. n., *Amyntas oviformis* sp. n., *Amyntas jindoensis* sp. n., *Amyntas jangbogoi* sp. n., *Amyntas deogyusanensis* sp. n., *Amyntas naejangensis* sp. n., *Amyntas draconis* sp. n., *Amyntas cuneatus* sp. n., *Amyntas yongshilensis* sp. n., *Amyntas alveolatus* sp. n., *Amyntas geomunensis* sp. n., *Amyntas eastoni* sp. n., *Amyntas boletiformis* sp. n., *Amyntas odae-sanensis* sp. n., *Amyntas righii* sp. n., *Amyntas fasciiformis* sp. n., *Amyntas sanchongensis* sp. n. Complete descriptions of the new species are provided, including illustrations of the male pore region and spermathecae.

Key-words: Earthworms - *Amyntas* - Megascolecidae - Oligochaeta - Korea - spermathecae - taxonomy

INTRODUCTION

Most Korean earthworm species within the Megascolecidae belong to the genus *Amyntas*. This group is diverse and abundant in litter layers and soils in forests. Parts of the Korean peninsula have been studied with regard to the taxonomy of Megascolecidae (Kobayashi, 1934, 1936, 1937, 1938; Song & Paik, 1969, 1970a, 1970b, 1971, 1973). Kobayashi recorded 29 species of *Amyntas* of which 18 were new species. Kobayashi collected several at locations in Korea including what is now North Korea. Song & Paik collected 9 species of this genus, including six new species from forest areas on Dagelet Isl., Jeju Isl., Geoje Isl., Mt. Jiri, and Mt. Sopaik. All Korean Megascolecidae were originally placed in *Pheretima* Kinberg, 1867, but *Pheretima* has since been divided by Sims & Easton (1972). Species with intestinal caeca originating in xxvii and lacking both nephridia on spermathecal ducts and copulatory pouches were placed in *Amyntas*.

Specimens were collected from 1996 to 1998, including islands and forests. Material was found from litter layers and soils in forests by digging and hand sorting from 48 locations. In this paper, 20 new to science are reported from South Korea. Korean *Amynthas* have five quantities of spermathecal pores; two pairs, three pairs, four pairs, five pairs, and none. Two pairs of spermathecal pores occur in three locations: 5/6 and 6/7, 6/7 and 7/8, 7/8 and 8/9, but all 20 new species reported here have pores in either 5/6-6/7 or 6/7-7/8. Including the species reported here for the first time, there are now 58 species of *Amynthas* known from Korea, and most are probably endemic to Korea. There is a little overlap between the area sampled for this paper and the areas covered by previous studies of Korean earthworms. This leaves substantial portions of South Korea, primarily in the Gangwon province and Gyeonggi regions, unsurveyed. Thus there may be many more species yet undiscovered in other islands and mountain ranges. The type material is deposited in the Korean Institute for Biodiversity Research (KIBIO), and Muséum d'histoire naturelle, Geneva, Switzerland.

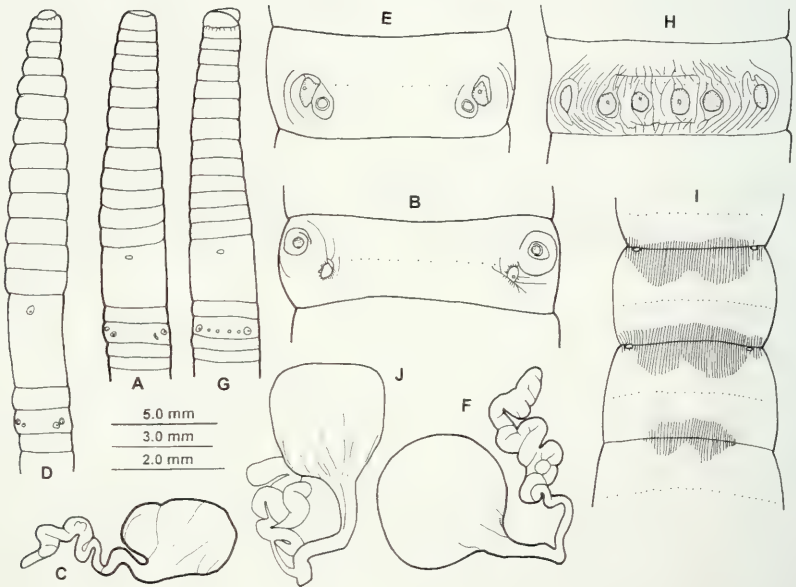


FIG. 1

A-C. *Amynthas piagolensis* sp. n. A: ventral view; B: male pore region in xviii; C: spermathecae. D-F. *Amynthas taebaekensis* sp. n. D: ventral view; E: male pore region in xviii; F: spermathecae. G-J. *Amynthas bubonis* sp. n. G: ventral view; H: male pore region in xviii; I: spermathecal pore region; J: spermathecae. Scales bars = 5 mm (A, D, G), 3 mm (C), 2 mm (B, E, F, H, I, J).

DESCRIPTIONS

Amynthas piagolensis sp. n.

Figs 1A-C

Material: Holotype and 5 paratypes: Korea, Jeollanam-do, Gurye-gun, Mt. Jiri. Piagol (35° 15'-18'N, 127° 33'-35'E), 600-1000 m, litter layers in forest, 22 August 1997, Y. Hong. (KIBIO). Other material: Same data as for holotype, 28 clitellate specimens.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in 5/6, 6/7, at leading edges of vi, vii. Male pores in post-setal medial to posterior edge of approximately circular thickened areas, with pre-setal, laterally placed circular genital papillae. Genital markings lacking.

Description: Dimensions 52-98 mm by 3.5-5.0 mm at segment x, 3.7-5.1 mm at xxx, 3.5-4.8 mm at clitellum; body cylindrical throughout, segments 58-78. Setae regularly distributed around segmental equators, numbering 48 at vii, 46 at xx; 13-14 between male pores, size and distance regular; setal formula AA:AB:YZ:ZZ = 3:2:3:5 at xiii. Female pore single in xiv, 0.5 mm oval shape. Prostomium epilobic, with tongue open. Light red (claret-purplish red) dorsally and yellowish ventrally, clitellum deep brownish, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male pores in post-setal slightly invaginated area medial to posterior edge of approximately circular thickened areas, each with pre-setal, laterally placed circular genital papillae. Spermathecal pores in 5/6 and 6/7, bright white spots at leading edge of vi, vii, ventrally. Genital markings not present in spermathecal segments.

Septa 5/6 thick, 6/7, 7/8 thin, 8/9, 9/10 absent, 10/11-12/13 thin. Gizzard largely in viii-x. Esophagous vertical lamellae xii, xiii. Intestine begins xv, lymph glands not found. Typhlosole absent. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxiv, each consisting of a medium size finger-shaped sac. Esophageal hearts four pairs in x-xiii. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles large in xi, xii, vesicles of xi extended into x. Prostates xviii extending to xvii-xx; having long muscular ducts with a hairpin bend, both glandular portions consist of two main lobes, each lobe divided into leaflets.

Ovaries in xiii. Paired spermathecae in vi, vii; ampulla large pouch, milky color, irregular shape, stout ducts shorter than ampulla, diverticulum coiled and kinked with short slender muscular stalk, some longer than ampulla; no nephridia on spermathecal ducts. Genital papillae in male pore invaginations with internal sessile glands medial to junctions of prostatic ducts with body wall.

Remarks: *Amynthas piagolensis* sp. n., the next ten species, and *A. reisuiensis* (Kobayashi, 1938) and *A. masatakae* (Beddard, 1892) which have spermathecal pores on 7/8, 8/9, all have simple intestinal caeca, and can thus be distinguished from other species with two pairs of spermathecae. Spermathecal pores of *A. piagolensis* sp. n. are on the anterior margins of vi and vii close to 5/6 and 6/7 ventrolaterally, but they are not intrasegmental. In this character *A. piagolensis* sp. n. is similar to *Amynthas taebaekensis* sp. n., *Amynthas bubonis* sp. n., and *Amynthas deogyusanensis* sp. n. All of them have spermathecal pores close to 5/6, 6/7. The present species appears to be

closely related to *A. taebaekensis* sp. n. from Mt. Taebaek, but it is separated easily by shape of male pore region. Genital papillae of *A. taebaekensis* sp. n. are post-setal, and *A. piagolensis*'s sp. n. papillae are somewhat protuberant.

Amyntas taebaekensis sp. n.

Figs 1D-F

Material: Holotype and 2 paratypes: Korea, Gangwon-do, Taebaek-shi, Mt. Taebaek (37° 07'N, 128° 57'E), 800-1200 m, litter layers in forest, 01 September 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 5 clitellate specimens.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in 5/6, 6/7, near leading edges of vi, vii; with triangular patches. Male pore area superficial near pad centers on 0.6-0.8 mm diameter oval papillae in setal line; paired post-setal genital papillae simple eye-spot shape. Genital markings lacking.

Description: Dimensions 68-95 mm by 4.5 mm at segment x, 4.5 mm at xxx, 4.2 mm at clitellum; body cylindrical throughout, segments 57-79. Setae regularly distributed around segmental equators, numbering 59 at vii, 56 at xx; 12-16 between male pores, size and distance regular; setal formula AA:AB:YZ:ZZ = 1:1:2:3 at xiii. Female pore single in xiv, 0.4 mm oval or round shape invaginate slightly. Prostomium epilobic, with tongue open. Brownish or dark brownish dorsally and yellowish ventrally, clitellum coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; slightly constricted and long, setae invisible externally.

Male pores near lateral margins of ventrum in xviii on thickened pads; pore area slightly superficial near pad centers on 0.6-0.8 mm diameter oval papillae in setal line, pores centered. Between male pores paired post-setal genital papillae simple eye-spot shape; diameter about 0.2 mm. Spermathecal pores in 5/6, and 6/7; near leading edges of vi, vii; triangular patches of short longitudinal furrows adjacent to spermathecal pores ventrally. Genital markings not present in spermathecal segments.

Septa 5/6 and 6/7 thick, 8/9 thin, 10/11-12/13 thin with some muscle. Gizzard globular in ix-x. Intestine begins in xv, lymph glands absent. Typhlosole very small in xxvi. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxiii, each consisting of a large finger-shaped sac. Hearts three pairs in xi-xiii, ix lateral, x lacking. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles filling most of two pairs in xi, xii. Prostates xviii middle within xvii-xx; ducts thick, medium length, both glandular portions consist of two or three main lobes. Genital papillae of xviii with small sessile gland patches near prostatic ducts, gland patches triangular or quadrilateral, closely attached to surface.

Ovaries in xiii. Paired spermathecae in vi, vii; vii larger than vi; each ampulla middle voluminous pouch, thick, short ducts, diverticula with long slender muscular stalk, ectal tightly coiled section of chamber ental loosely coiled section of greater diameter; no nephridia on spermathecal ducts.

Remarks: The present species appears to be closely related to *A. piagolensis* sp. n. from Mt. Jiri, but is separated easily by shape of the male pore region and spermathecal pore patches, which are location *A. piagolensis* sp. n. Genital papillae of *A. piagolensis* sp. n. are pre-setal, as opposed to post-setal in *A. taebaekensis* sp. n.

Amyntas bubonis sp. n.

Figs 1G-J

Material: Holotype and 5 paratypes: Korea, Gyung-sangnam-do, San-chong-gun, Mt. Jiri (35° 22'-25'N, 127° 50'-52'E), 600-850 m, litter layers in forest, 30 August 1997, Y. Hong, (KIBIO). Other material: Jeollan-am-do, Gurye-gun, Mt. Jiri, Piagol, 600-1000 m, litter layers, 1 clitellate, 22 August 1997; Jeollabuk-do, Namwon-gun, Mt. Jiri, Manbokdae (35° 20'-22'N, 127° 31'-33'E), 1100-1400 m, litter layers, 2 clitellate, 31 August 1997; Jeollabuk-do, Jangsu-gun, Mt. Jangan, 600-850 m, litter layers, 26 clitellate, 2 a clitellate, 28 July 1998; Gyung-sangbuk-do, Kimchon-shi, Mt. Hwangakg, Jikji-sa (36° 06'-08'N, 128° 00'-02'E), 200-600 m, litter layers, 17 clitellate, 1 a clitellate, 30 July 1998; Gyung-sangnam-do, Hamyang-gun, Mt. Baekun, 400-700 m, litter layers, 44 clitellate, 07 August 1998; Jeollan-am-do, Gurye-gun, Mt. Jiri, Nogodan (35° 16'-18'N, 127° 32'-34'E), 1000-1400 m, litter layers, 6 clitellate, 19 August 1998; Gyung-sangnam-do, San-chong-gun, Mt. Jiri, 600-1200 m, litter layers, 9 clitellate, 30 August 1997.

Etymology: The epithet *bubonis*, Latin for owl, alludes to the conspicuous genital papillae in this species.

Diagnosis: Spermathecal pores ventral on anterior edges of vi, vii, close to 5/6, 6/7; genital patches unpaired, median between spermathecal pores. Male pores at center of round male patches 0.3 mm diameter near lateral margins of xviii, lateral to 2-6 round genital papillae. Genital markings lacking.

Description: Dimensions 57-99 mm by 3.3-4.0 mm at segment x, 3.5-4.2 mm at xxx, 3.5-4.2 mm at clitellum; body cylindrical throughout and narrowed in vi, vii, segments 64-86. Setae regularly distributed around segmental equators, numbering 43 at vii, 44 at xx; 13-16 between male pores, irregular distance; setal formula AA:AB:YZ:ZZ = 2:2:2:3 at xiii. Female pore single in xiv, 0.35 mm round or oval shape slightly invaginate. Prostomium epilobic, with tongue open. Red brownish dorsally and yellowish ventrally, clitellum light coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male pores at center of round male patches 0.3 mm diameter near lateral margins of ventrum in xviii, pores white, flanked by 5-7 very small longitudinal wrinkles, convex laterally, lateral to genital papillae, the outer most one or two wrinkles lateral to male pores. Between male pores 3-5 round genital papillae (2-6 in non-type material) 0.2 x 0.2 mm darker than body wall, post-setal on transverse raised area also encompassing male pores, conspicuous slight superficial round shape, regularly spaced distance and all of similar shape, more conspicuous than male pore papillae. Spermathecal pores ventral on anterior edges of vi and vii, very close to 5/6, 6/7 respectively, about 1/3 circumference apart. Each a clear white spot, flat on top, with conspicuous opening. Genital patches unpaired, median between spermathecal pores on 5/6, 6/7, and in same area of 7/8; each patch composed of many small furrows extending across intersegment boundary, but not reaching segmental equators. Genital markings lacking.

Septa 5/6 and 6/7 thick, 11/12-13/14 thin with some muscle. Gizzard moderately globular in viii-ix. Intestine begins in xiv, lymph glands none. Typhlosole small from xxvii. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxiii, each consisting of a finger-shaped large sac. Esophageal hearts xi-xiii, connected to supra-esophageal vessel, x missing; ix lateral. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles simple, medium

size, two pairs in xi, xii. Prostates xviii centered in xvi-xx; ducts long muscular, both glandular portions consist of two or three main lobes, each with smaller divisions.

Ovaries free in xiii. Paired spermathecae in vi, vii, each ampulla large rounded to blocky; conspicuous blood vessel on ducts. Ducts longer than ampulla, diverticula with slender muscular stalk; increasing in diameter ectally; coiled; diverticulum chamber coiled, increasing in diameter towards end; no nephridia on spermathecal ducts. Genital papillae of xviii with sessile and very small stalked glands corresponding approximately in number and location to the externally visible genital papillae, resembling very small prostates in shape.

Remarks: The species has variable genital papillae. Kimchon specimens have a more variable number of genital papillae from 2 to 6, and sometimes two genital papillae are attached to one another. Also, genital papillae glands are missing in Kimchon specimens, which also sometimes have very small spermathecae. In five of 16 individuals, the anterior spermathecal patch boundary is very close to the intersegmental boundary. Jangan and Baekun specimens have patches, but very weakly developed. All Nogodan specimens lacked the median genital papillae of xviii, having only two papillae, those close to the male pore papillae. Three spermathecal pores appear intersegmental in one individual from Manbokdae.

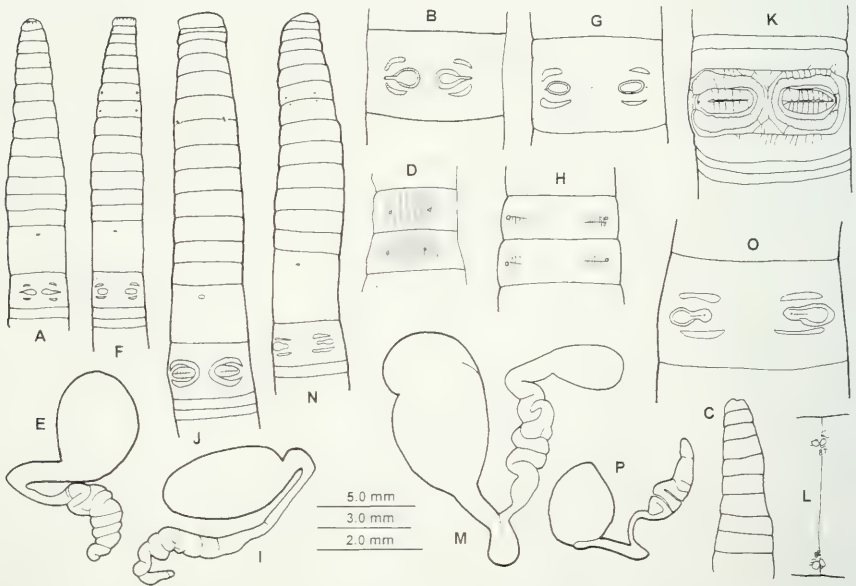


FIG. 2

A-E. *Amynthus vicinus* sp. n. A: ventral view; B: male pore region in xviii; C: lateral view, anterior of clitellum; D: spermathecal pore region; E: spermathecae. F-I. *Amynthus oviformis* sp. n. F: ventral view; G: male pore region in xviii; H: spermathecal pore region; I: spermathecae. J-M. *Amynthus jindoensis* sp. n. J: ventral view; K: male pore region in xviii; L: spermathecal pores of vi and vii; M: spermathecae. N-P. *Amynthus jangbogoi* sp. n. N: ventral view; O: male pore region in xviii; P: spermathecae. Scales bars = 5 mm (A, C, F, J, N), 3 mm (B, D, E, G, H, K, L, O, P), 2 mm (I, M).

Amyntas vicinus sp. n.

Figs 2A-E

Material: Holotype and 4 paratypes: Korea, Jeollabuk-do, Jangsu-gun, Mt. Jangan (35° 37'-38'N, 127° 36'-37'E), 600-850 m, litter layers in forest, 28 July 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 22 clitellate, 2 acitellate specimens.

Etymology: The name *vicinus* is Latin for neighboring, which recognizes the species close relationship to *A. plantus* (Song & Paik, 1973) and *Amyntas oviformis* sp. n.

Diagnosis: Spermathecal pores in vi, vii intrasegmental; between pores flat a setal area with longitudinal furrows forming genital patch. Male pores superficial at ends of thin pale lines extending laterally from closely paired ovate discs slightly elevated. Genital markings lacking.

Description: Dimensions 67-90 mm by 3.8-4.2 mm at segment x, 3.8-4.2 mm at xxx, 4.0-4.2 mm at clitellum; body cylindrical throughout in narrow vi, vii, segments 62-99. Setae regularly distributed around segmental equators, numbering 32 at vi, 36 at vii, setae missing between spermathecal pores, 52 at xx; no setae between male pores, but not in at xviii; setal formula AA:AB:YZ:ZZ = 2:1:2:3 at xiii. Female pore single in xiv, 0.3 mm oval shape. Prostomium epilobic, with tongue open. Light brownish dorsally and yellowish ventrally, clitellum light coffee color, faintly extended beyond 13/14 and 16/17, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally, very smooth surface, dorsal pores visible.

Male pores superficial at ends of thin pale lines extending laterally from closely paired ovate discs slightly elevated; wing-shaped short bands anterior and posterior of the genital papillae have lateral ends close to line leading to male pore, curving half way around genital papillae. Paired spermathecal pores vi, vii intrasegmental, just pre-setal, ventral; small light flattened spot; between pores flat a setal area with slight longitudinal furrows forming genital patch width corresponding to 12-14 setae in adjacent segments. Genital markings lacking.

Septa 5/6, 6/7 thick, 7/8 slightly muscular, 8/9, 9/10 absent, 10/11-13/14 thin with some muscle. Gizzard globular in viii-x. Intestine begins in xiv, very small lymph glands from xxvii. Typhlosole simple fold from xxvii. Hearts in ix lateral, x-xiii esophageal. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxiii, each consisting of a straight slightly tapered sac. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles medium size, two pairs in xi, xii; vesicles of xi joined dorsally, in xii not connected. Prostates small within xvi-xx; ducts thick, short, both glandular portions consist of two or three main lobes.

Ovaries in xiii. Paired spermathecae in vi, vii; each ampulla voluminous oval pouch, ducts thick, slightly shorter than ampulla, diverticula thin, coiled except for muscular stalk, as long as ampulla, or sometimes slightly shorter than ampulla; no nephridia on spermathecal ducts.

Remarks: The present species appears to be closely related to *A. oviformis* sp. n., but is separated easily by the shape of the male pore region. The male pores of the species are connected with genital papillae, but in *A. oviformis* sp. n. they are

separated. Genital patches of the species are unpaired between spermathecal pores, but in *A. oviformis* sp. n. the patches are paired around the spermathecal pores. *A. oviformis* sp. n. is similar to *A. plantus*, in that the male pores and genital patches are separated. Also, *Amyntas vicinus* sp. n. has intrasegmental spermathecal pores, in which it is similar to *A. oviformis* sp. n., *Amyntas jangbogoi* sp. n., *Amyntas cuneatus* sp. n. and *A. plantus*. We think it is necessary to make a distinction between species whose spermathecal pores are close to intersegmental boundaries and those with spermathecal pores well within the segments. *A. vicinus* sp. n. has ventral genital patches in place of genital markings, the same as *Amyntas seungpanensis* (Song & Paik, 1970), *A. oviformis* sp. n., *A. cuneatus* sp. n., and *A. plantus*. Also, *A. vicinus* sp. n. has unpaired mid-ventral genital patches, unlike the others just mentioned, which have paired genital patches. The body wall is so thin that parasite cysts were visible without dissection, and segments vi and vii are conspicuously flattened or constricted, as in *Amyntas agrestis* (Goto & Hatai, 1899).

Amyntas oviformis sp. n.

Figs 2F-I

Material: Holotype and 3 paratypes: Korea, Jeollanam-do, Wando-gun, Geomun Isl. (34° 01'-02'N, 127° 21'E), 50-100 m, soil and litter layers in forest, 06 September 1996, Y. Hong, (KIBIO). Other material: Same data as for holotype, 11 clitellate, 1 acitellate specimens.

Etymology: This species named *oviformis*, Latin for egg, referring to the shape of the male pore region.

Diagnosis: Spermathecal pores in vi, vii intrasegmental; genital patches paired vi, vii, lateral edges surrounding spermathecal pores. Male pores near lateral margins in xviii. Genital markings lacking.

Description: Dimensions 53-105 mm by 3.6-4.0 mm at segment x, 3.6-4.1 mm at xxx, 3.2-4.3 mm at clitellum; body cylindrical throughout, segments 54-86. Setae irregularly distributed around segmental equators, numbering 34-43 at vi, 32-39 at vii, 51 at xx, invisible medial to spermathecal pores except for 3-10 setae near mid-ventral line; 0-4 setae between male pores, setal formula AA:AB:YZ:ZZ = 2:1.5:2:3 at xiii. Female pore single in xiv, 0.2-0.3 mm oval shape. Prostomium epilobic, with tongue open. Pink dorsally and yellowish ventrally, clitellum dark more red color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible, dorsal pores visible externally.

Male pores near lateral margins of ventrum in xviii, at lateral edges of paired, raised transverse oval papillae. Paired slightly curved dark bands anterior, posterior to papillae approximately on 17/18, 18/19; in some specimens bands are slightly invaginated, all bands longer than oval genital papillae. Spermathecal pores vi, vii intrasegmental, small flattened spot just pre-setal, the pore superficial, conspicuously black; genital patches paired vi, vii, lateral edges surrounding spermathecal pores, patches oval, with a few small furrows; setae lacking within patches. Genital markings lacking.

Septa 4/5 thick, 6/7-7/8 thinner but muscular, 8/9, 9/10 absent, 10/11 thin, 11/12-13/14 thin with some muscle. Gizzard globular in vii-ix. Intestine begins in xiv, one pair of lymph glands per segment from xxvii. Typhlosole simple fold from xxvii.

Hearts in ix lateral, x-xiii esophageal. Intestinal caeca simple, medium size, originating in xxvii, extending anteriorly about to xxii, each consisting of simple finger-shaped sac. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs xi, xii; pair in xi connection joined, xii separate, with many round white spots dorsally. Prostates xviii, extending to xvi-xxi; both glandular portions consist of two or three main lobes; short thick cylindrical ducts.

Ovaries in xiii. Paired spermathecae vi and vii, each ampulla a small oval pouch, slightly flattened; ducts thick, short; diverticula with long muscular stalk, ectal portion long and coiled with many small pockets in diverticulum walls, longer than ampulla; no nephridia on spermathecal ducts. Genital marking glands lacking.

Remarks: The present species appears to be closely related to *A. plantus*, but is separated easily by the shape of the male pore region, and because it differs in that the male pores are not within the genital papillae. *A. plantus* has male pores in the genital papillae, and like *A. oviformis* sp. n. has paired genital patches. The acitellate individual lacked visible genital papillae, but has clearly visible male pores and genital papillae.

Amynthas jindoensis sp. n.

Figs 2J-M

Material: Holotype and 3 paratypes: Korea, Jeollanam-do, Jindo-gun, Jindo-eup (34° 37'-38'N, 126° 19'E), 100-300 m, litter layers in forest, 22 August 1998, Y. Hong, (KIBIO). Other material: Jeollanam-do, Jindo-gun, Jindo-eup, 7 clitellate, 25 August 1998.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores posterior edge of vi, anterior edge of vii; pores of vi usually farther from 6/7 than pores of vii. Male pores at lateral ends of large elliptical pads. Genital markings lacking.

Description: Dimensions 78-123 mm by 4.3-5.2 mm at segment x, 4.6-5.3 mm at xxx, 4.9-5.4 mm at clitellum; body cylindrical throughout, segments 67-105. Setae regularly distributed around segmental equators, numbering 52 at vii, 61 at xx; 0 between male pores; setal formula AA:AB:YZ:ZZ=2:1:1:2 at xiii. Female pore single in xiv, 0.5 mm oval shape with split. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum medium dark coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male pores at lateral ends of large elliptical pads, each pad split by transverse groove extending from inner lateral margin of ellipse through outer medial margin. Elliptical pads surrounded by second elliptical or slightly angular open ring of darker thickened tissue; outer ring open laterally; outer rings extend almost to equators of xviii, xix. Further thickened region with or without rugosities may extend more laterally and posteriorly to 19/20. Paired spermathecal pores posterior edge of vi, anterior edge of vii; pores of vi usually farther from 6/7 than pores of vii; pores of vi are slightly more laterally placed; pores on circular porophores protruding towards 6/7. Genital markings lacking.

Septa 5/6-7/8 thick, 8/9, 9/10 absent, 10/11-12/13 with thin, some muscle. Gizzard nearly spherical viii-x. Intestine begins in xv, lymph glands from xxvii on

dorsal vessel. Typhlosole low, simple fold from xxvii. Esophageal hearts in x-xiii; ix lateral, usually one large, one small or aborted. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxii, each consisting of a middle finger-shaped sac. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles nearly filling their segments, paired in xi, xii. Prostates xviii, extending to xvi-xx, attached to tip of cecum; short muscular ducts, both glandular portions consist of three main lobes, these divided again in simple leaflets. Genital marking glands lacking.

Ovaries in xiii. Paired spermathecae in vi, vii, ducts enter body wall close to 6/7, each ampulla large, egg-shaped, ducts short, thick; diverticula slender, ectal 1/3 straight, center 1/3 with 6-8 tight kinks, ental part straight, diameter greater; longer than ampulla; no nephridia on spermathecal ducts.

Remarks: The present species appears to be related to *A. jangbogoi* sp. n., but is separated easily by the shape of the male pore region and spermathecal pore region. The location of spermathecal pores is unusual in *Amyntas*, in that spermathecal pores of two adjacent segments appear near the same intersegmental boundary. This may be important in the systematics of Korean *Amyntas*. *A. seungpanensis* has a similar arrangement of spermathecal pores, but has only a single mid-ventral pore in each of vi and vii. Having no setae between male pores, *A. jindoensis* sp. n. is similar to *A. vicinus* sp. n., *A. seungpanensis*, and *A. plantus* among Korean *Amyntas*. The male disc shape is unique to this species.

Amyntas jangbogoi sp. n.

Figs 2N-P

Material: Holotype and 2 paratypes: Korea, Jeollanam-do, Wando-gun, Wando-eup (34° 20'-22'N, 126° 41'E), 100-600 m, litter layers in forest, 26 August 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 2 clitellate specimens.

Etymology: Named for General Bo-Go Jang (849-935), a navy man active on the sea near Wando.

Diagnosis: Spermathecal pores in vi near segmental equator, in vii near 6/7 but not intersegmental. Male pores superficial in xviii at medial ends of paired transversely oriented bowling-pin shaped pads. Genital markings lacking.

Description: Dimensions 94-117 mm by 4.8 mm at segment x, 5.0 mm at xxx, 4.8 mm at clitellum; body cylindrical throughout, segments 85-102. Setae regularly distributed around segmental equators, numbering 51 at vii, 54 at xx; 3-8 between male pores, size and distance irregular; setal formula AA:AB:YZ:ZZ = 3:2:3:5 at xiii. Female pore single in xiv, oval shape, conspicuous. Prostomium epilobic, with tongue open. Red brownish dorsally and yellowish ventrally, clitellum with light coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores open externally within clitellum.

Male pores small white spots superficial in xviii at medial ends of paired transversely oriented bowling-pin shaped pads, head of pin towards mid-ventral; anterior and posterior to the male pores are transverse dark, bands extending from just medial of male pore to lateral margin of ventrum; hardened dark grooves around pad margins. Paired spermathecal pores in vi near segmental equator, in vii near 6/7 but not intersegmental. Genital markings lacking.

Septa 5/6, 6/7 thick, 7/8 some muscle, 8/9, 9/10 absent, 10/11-12/13 thin. Gizzard in viii-x. Intestine begins in xv, very small white lymph glands from about xx. Typhlosole simple low fold from xxvii. Hearts in x-xiii esophageal; ix lateral. Intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxii, each consisting of a large finger-shaped sac. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Paired seminal vesicles filling segments xi, xii. Prostates xviii extending to xvi-xxi, short and very thick barrel shaped ducts, both glandular portions consist of three main lobes.

Ovaries in xiii. Paired spermathecae in vi and vii, vii little larger than vi, ampulla ovate, medium size, duct about as long as ampulla, diverticula with straight muscular stalk, coiled middle section and digitate end, diverticulum as long as duct-ampulla axis; no nephridia on spermathecal ducts.

Remarks: The location of the spermathecal pores in this species is very unusual, since it has one pair equatorial in vi and one pair intrasegmental but close to 6/7. This arrangement appears to be an intermediate stage between the common arrangement of spermathecal pores (intersegmental) and that seen in *A. jindoensis* sp. n. In *A. jindoensis* sp. n. the spermathecal pores of vi have moved back to be near 6/7, while in *A. jangbogoi* sp. n. these pores have only moved back to the segmental equator. Among Korean *Amynthas*, posterior shift of the spermathecal pores is only seen in these species.

Amynthas deogyusanensis sp. n.

Figs 3A-C

Material: Holotype and 2 paratypes: Korea, Jeollabuk-do, Muju-gun, Mt. Deogyu (35° 53'-55'N, 127° 46'-47'E), 400-1000 m, litter layers in forest, 04 July 1998, Y. Hong, (KIBIO).

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in vi, vii close to 5/6 and 6/7; paired genital patches laterally vi and vii, ocher color conspicuous. Male pores superficial at median ends of seminal grooves within paired hardened male discs. Genital markings lacking.

Description: Dimensions 102-110 mm by 5.0-5.7 mm at segment x, 4.8-5.3 mm at xxx, 5.3-6.0 mm at clitellum; body cylindrical throughout, segments 104-106. Setae regularly distributed around segmental equators, numbering 6-7 at vi, 14-18 at vii; setae may be present in ocher genital patches but very hard to see, 59 at xx; 8-11 between male pores, size and distance regular; setal formula AA:AB:YZ:ZZ = 2.5:2:2:5 at xiii. Female pore single in xiv, 0.7 mm oval shape slightly invaginate. Prostomium epilobic, with tongue open. Pink brownish dorsally and yellowish ventrally, clitellum with light coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male pores superficial at median ends of seminal grooves within paired hardened male discs; disc shape resembles droplet placed with narrow end lateral, raised above body wall level, central axis with a diagonal seminal groove, lateral end posterior to medial end. Spermathecal pores in vi, vii close to 5/6 and 6/7, above mid-lateral level or 1/2 circumference apart, slightly elevated conspicuous small flat-top spot, pore opening appears black. Paired genital patches laterally vi and vii, ocher color conspicuous, 2/3 or more of body circumference.

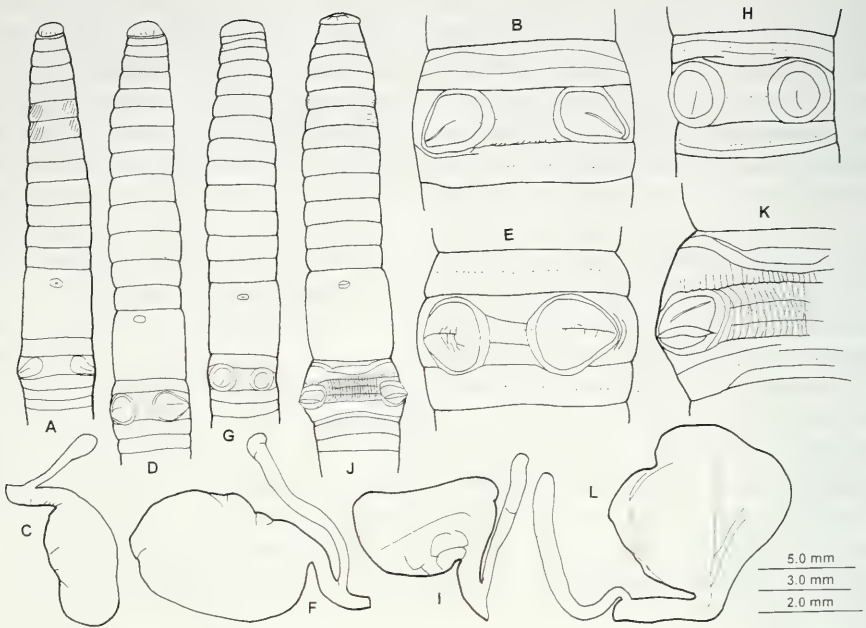


FIG. 3

A-C. *Amynthus deogyusanensis* sp. n. A: ventral view; B: male pore region in xviii; C: spermathecae. D-F. *Amynthus naejangensis* sp. n. D: ventral view; E: male pore region in xviii; F: spermathecae. G-I. *Amynthus draconis* sp. n. G: ventral view; H: male pore region in xviii; I: spermathecae. J-L. *Amynthus cuneatus* sp. n. J: ventral view; K: male pore region in xviii; L: spermathecae. Scales bars = 5 mm (A, D, G, J), 3 mm (B, E, H, K), 2 mm (C, F, I, L).

Septa 5/6 and 6/7 thick, 7/8 some muscle, 8/9, 9/10 absent, 10/11, 11/12 thick, 12/13-13/14 thin with some muscle. Gizzard globular in viii-x. Intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel. Typhlosole low simple fold from xxvii. Hearts x-xiii esophageal: ix lateral, one side always larger than other. Intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiii, each consisting of a large finger-shaped sac, well developed. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii, well developed. Prostates xviii, divided in many long slender lobes extending to xvi-xviii, many pieces. Genital marking glands lacking.

Ovaries in xiii. Paired spermathecae in vi, vii; ampulla small pouch, ducts shorter than ampulla, diverticula club-shaped; no nephridia on spermathecal ducts.

Remarks: The species shares some characteristics of the male pore region with *Amynthus fibula ranunculus* (Kobayashi, 1936). It differs from *A. fibula ranunculus* in the orientation of the male disc droplet shape head direction and location of the male pores. All individuals of *A. deogyusanensis* sp. n. collected from the same site have similar characteristics, but droplet head direction was reversed in two indivi-

duals. Also, the species has more dorsally placed spermathecal pores, in which it is similar to *A. cuneatus* sp. n., and *Amynthas kobayashii* (Kobayashi, 1938) and *Amynthas vallis* (Kobayashi, 1936) though this last has three spermathecal pores in 5/6-7/8. Twelve of the new species with spermathecal pores in 5/6, 6/7 have no genital markings. *A. deogyusanensis* sp. n. also lacks genital markings and only has conspicuous genital patches.

Amynthas naejangensis sp. n.

Figs 3D-F

Material: Holotype and 1 paratype: Korea, Jeollabuk-do, Jeongeup-gun, Mt. Naejang (35° 29'-30'N, 126° 54'E), 200-600 m, soil and litter layers in forest, 29 June 1996, Y. Hong, (KIBIO).

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in 5/6, 6/7 close to mid-lateral. Male field with large egg-shaped raised pads; each pad extending from 17/18-18/19. Genital markings lacking.

Description: Dimensions 116-153 mm by 6.2 mm at segment x, 6.0 mm at xxx, 6.2 mm at clitellum; body cylindrical throughout, segments 96-117. Setae regularly distributed around segmental equators, numbering 15-39 at vi, 12-42 at vii, 58-64 at xx; 5-11 between male pores, size and distance regular; setal formula AA:AB:YZ:ZZ = 3:2:2.5:4 at xiii. Female pore single in xiv, 1.0 mm oval shape. Prostomium epilobic, with tongue open. Light pink dorsally and yellowish ventrally, clitellum with light coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae only faint traces visible externally.

Male field with large egg-shaped raised pads, narrow end lateral; each pad extending from 17/18-18/19, with transverse seminal groove from approximate center of broad end of pad to just within lateral edge; male pores at medial ends of grooves. Some pads elevated towards seminal grooves, others with central ridge posterior to grooves. Paired spermathecal pores 5/6, 6/7 close to mid-lateral, inconspicuous, very small. Genital markings lacking.

Septa 5/6-7/8 thick, 8/9, 9/10 absent, 10/11-13/14 thin with some muscle. Gizzard small in viii-x. Intestine begins in xv, lymph glands from xv. Typhlosole large from xxvii. Intestinal caeca simple, originating in xxvii, extending anteriorly about to xxii, each consisting of a large finger-shaped sac with small pouches on ventral margin. Esophageal hearts x-xiii. Male sexual system holandric, testes and funnels enclosed in dorsally united, ventrally separate sacs, sac membrane xi also encloses seminal vesicles of xi. Seminal vesicles, two pairs xi and xii; enclosed in testis sac in xi. Prostates xviii extending to xvii-xix; short and thick ducts, both glandular portions consist of two or three main lobes, each lobe deeply divided into leaflets, intestine of xviii constricted by prostates. Genital papillae glands lacking.

Ovaries in xiii. Paired spermathecae in vi, viii; each ampulla pear-shaped pouch; ducts short stalks, diverticula somewhat slender and thin, shorter than ampulla, straight or slightly curved; not coiled; no nephridia on spermathecal ducts.

Remarks: The present species appears to be closely related to *Amynthas draconis* sp. n., but is separated easily by the shape of the male pore pad, shape and

direction of the seminal grooves and other characters. *Amyntas naejangensis* sp. n. is also larger than *A. draconis* sp. n.

Amyntas draconis sp. n.

Figs 3G-I

Material: Holotype and 2 paratypes: Korea, Jeollabuk-do, Jangsu-gun, Waryong-ri (35° 40'-41'N, 127° 29'E), 600-700 m, litter layers in forest, 03 August 1996, Y. Hong, (KIBIO).

Etymology: The species is named for its type locality. Waryong means "dragon lying down".

Diagnosis: Spermathecal pores in 5/6, 6/7. Male pores xviii in large circular papillae, each papilla with seminal groove of variable shape, some longitudinal, some T-shape. Genital markings lacking.

Description: Dimensions 103-123 mm by 5.3-5.5 mm at segment x, 5.0-5.2 mm at xxx, 5.1-5.5 mm at clitellum; body cylindrical throughout, segments 121-125. Setae regularly distributed around segmental equators, numbering 42 at vii, 59 at xx; 7-10 between male pores; setal formula AA:AB:YZ:ZZ = 3:2:2:4 at xiii. Female pore single in xiv, 0.8 mm oval shape. Prostomium epilobic, with tongue open. Grayish dorsally and yellowish ventrally, clitellum brownish, formalin preservation. First dorsal pore 12/13 (1 individuals) or 13/14 (1 individuals). Clitellum annular xiv-xvi; setae invisible externally.

Male pores xviii in large circular papillae diameter 1.5 x 1.3 mm with outer ring 2.0-1.6 mm outside, each papilla with seminal groove of variable shape, some longitudinal, some T-shape. Paired spermathecal pores 5/6, 6/7 very faint, only recognizable in one individual. Genital markings lacking.

Septa 5/6-7/8 thick, 8/9, 9/10 absent, 10/11 thick, 11/12-13/14 thin. Gizzard in viii-x. Intestine begins in xv, lymph glands from xxvii. Typhlosole simple fold from xxvii. Intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiv, each consisting of a finger-shaped sac. Esophageal hearts four pairs in x-xiii. Male sexual system holandric, testes and funnels in ventral enclosed paired sacs in x, xi; xi sacs united dorsally. Seminal vesicles, two pairs in xi and xii; xi enclosed in testis sacs. Prostates xviii extending to xiv-xx; both glandular portions consist of five main lobes, deeply divided in slender leaflets. Genital papillae glands lacking.

Ovaries in xiii. Paired spermathecae in vi, vii; vii larger than vi; each ampulla with furrowed pouch, ducts of medium thickness, diverticula slender, digitate, with narrow stalk, shorter than ampulla; no nephridia on spermathecal ducts.

Remarks: The present species appears to be closely related to *A. naejangensis* sp. n., but is separated easily by the shape of the male pore region. The male pore disc is close to being circular.

Amyntas cuneatus sp. n.

Figs 3J-L

Material: Holotype and 2 paratypes: Korea, Jeollanam-do, Gurye-gun, Mt. Jiri, Piagol (35° 15'-18'N, 127° 33'-35'E), 600-1000 m, soil and litter layers in forest, 26 July 1996, Y. Hong, (KIBIO).

Etymology: The name *cuneatus* is Latin for wedge, here referring to the shape of the male pore region.

Diagnosis: Spermathecal pores in vi, vii above mid-lateral level in dorsal half. Male field area xvii-xix complex; papillae of xviii asymmetrically oval in ventral view, wedge-shaped in longitudinal section. Genital markings lacking.

Description: Dimensions 146-151 mm by 6.1-6.6 mm at segment x, 5.8-6.4 mm at xxx, 6.6-7.0 mm at clitellum; body cylindrical throughout, segments 127-132. Setae regularly distributed around segmental equators, numbering 13 at vi, 11 at vii, 31 at viii, 74 at xx; 11-12 between male pores; these setae regularly spaced but difficult to find due to swelling and furrows between male pores; setal formula AA:AB:YZ:ZZ = 4:2.5:2.5:3 at xiii. Female pore single in xiv, invaginate 1.0 mm oval shape. Prostomium epilobic, with tongue open. Dark grayish dorsally and yellowish ventrally, clitellum reddish brown, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male field area xvii-xix complex. Paired corrugated epidermal thickenings over equatorial, post-setal two thirds of xvii; also on equatorial, pre-setal two thirds of xix; thickenings of xvii larger; the two pairs flanking large paired papillae of xviii. Papillae of xviii asymmetrically oval in ventral view, wedge-shaped in longitudinal section, with central ridge transversely placed post-setally. Anterior face of genital papillae with transverse seminal grooves lateral ends of which originate just anterior to lateral 1/3 of central ridge, then grooves extend diagonally anterior and medial to end at inner edge of dark ring marking edge of genital papillae. Male pores at medial ends of seminal grooves. Paired spermathecal pores 0.1 mm small white spots pre-setal in vi, vii above mid-lateral level in dorsal half. Ocher color genital patches 3.5-4.5 mm in vi, vii around spermathecal pores, clearly visible to naked eye, diffuse, covering 1/2 dorsal surface, separated by narrow dorsal gap, broad ventral gap.

Septa 5/6, 6/7 thick, 7/8 thinner but some muscle, 8/9, 9/10 absent, 10/11-12/13 thickly muscular. Gizzard globular in viii-x, esophagus vascularized, with vertical lamellae xii, xiii. Intestine begins xv, lymph glands from xxvii. Typhlosole in xxvii. Esophageal hearts in xi-xiii; ix lateral, x not found. Intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiii, each consisting of a finger-shaped sac, finger directed to ventral side of intestine. Male sexual system holandric, testes and funnels in ventral enclosed paired sacs in x, xi, smaller in xi. Seminal vesicles xi with one large section connected by narrow canal to smaller part adherent to posterior face of septum 10/11. Both enclosed in membrane. Seminal vesicles xii consist of lateral larger part covering medial rounded lobe resembling the testis sacs of some species. Prostates xviii, extending to xvi-xxi, each divided in 5-6 main parts, divided into long slender lobes, ducts thick, shorter than prostate gland lobe.

Ovaries in xiii. Paired spermathecae vi and vii, vii little larger than vi; each ampulla large voluminous pouch covered by membrane laced with thin blood vessels, ducts shorter than ampulla, diverticula slender, with stalk same length as spermathecal ducts, diverticulum chamber sausage-shaped, straight; no nephridia on spermathecal ducts. Genital marking glands lacking.

Remarks: The present species appears to be closely related to *Amynthas koryoensis* (Kobayashi, 1936) which also has very large male genital papillae, but in

A. cuneatus sp. n. they are wedge-shaped in longitudinal section with a central ridge transversely placed post-setally, and a diagonal groove on the anterior face of the wedge. *A. cuneatus* sp. n. also differs in the number and location of spermathecal pores.

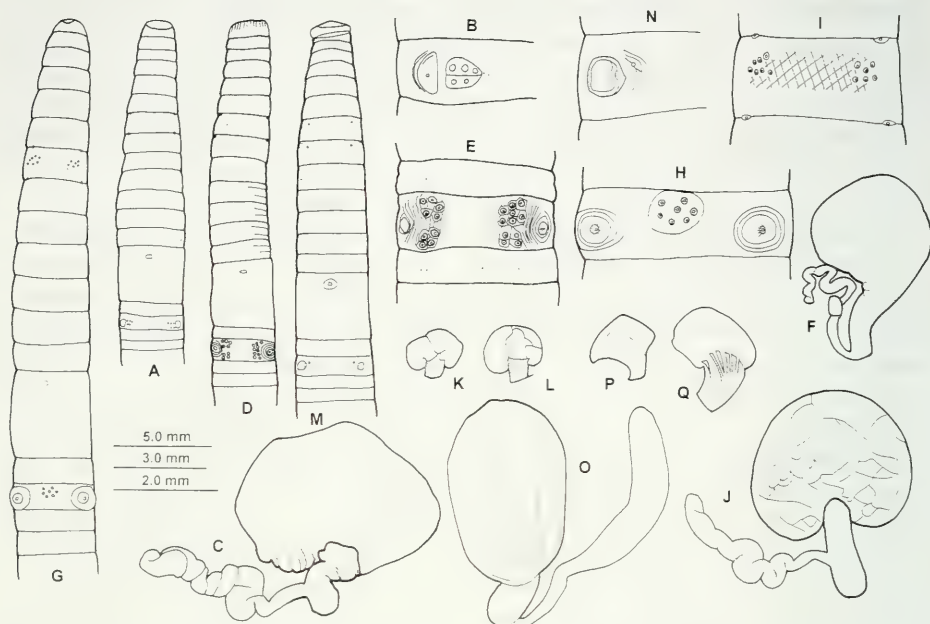


FIG. 4

A-C. *Amynthus yongshilensis* sp. n. A: ventral view; B: male pore region in xviii; C: spermathecae. D-F. *Amynthus alveolatus* sp. n. D: ventral view; E: male pore region in xviii; F: spermathecae. G-L. *Amynthus geomunensis* sp. n. G: ventral view; H: male pore region in xviii; I: spermathecal pore region; J: spermathecae; K: genital marking glands in vii; L: genital papillae glands in xviii. M-Q. *Amynthus eastoni* sp. n. M: ventral view; N: male pore region in xviii; O: spermathecae; P: genital papillae glands in xviii; Q: genital marking glands in viii. Scales bars = 5 mm (A, D, G, M), 3 mm (E, H, I, N), 2 mm (B, C, F, J, K, L, O, P, Q).

***Amynthus yongshilensis* sp. n.**

Figs 4A-C

Material: Holotype and 3 paratypes: Korea, Jeju-do, Mt. Halla, Yongshil (33° 23'-25'N, 126° 33'-35'E), 1000-1400 m, litter layers in forest, 15 August 1997. Y. Hong, (KIBIO). Other material: Same data as for holotype, 16 clitellate, 27 aclitellate specimens.

Etymology: The species is named after the type locality.

Diagnosis: Spermathecal pores in 6/7, 7/8. Male pores near lateral margins of xviii, pore superficial white spot near bright white medial margin of 0.6-0.8 mm pad; between male pores two rows of small round genital papillae. Genital markings lacking.

Description: Dimensions 60-101 mm by 4.0-5.3 mm at segment x, 4.2-5.2 mm at xxx, 4.3-5.6 mm at clitellum; body cylindrical throughout, segments 77-93. Setae regularly distributed around segmental equators, numbering 43 at vii, 41 at xx; 7-15 between male pores, some regular; setal formula AA:AB:YZ:ZZ = 5:4:5:6 at xiii. Female pore single in xiv, 0.7 mm round or oval shape. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible, dorsal pores visible or invisible.

Male pores near lateral margins of ventrum in xviii, pore superficial white spot near bright white medial margin of 0.6-0.8 mm pad. Between pores two rows of small round genital papillae, 2-6 pre-setal, 2-6 post-setal in xviii. Paired spermathecal pores 6/7, 7/8 small white spot on 0.1 mm diameter circular porophore, sometimes similar appearance to male pores.

Septa 5/6, 6/7 thick, 7/8 thin, 8/9, 9/10 absent, 10/11-13/14 thin. Gizzard globular in viii-x. Intestine begins in xv, lymph glands from xxvii, small, thin. Typhlosole small in xxvi. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxii, each consisting of 5 finger-shaped sacs, more ventral ones becoming gradually smaller. Hearts esophageal x-xiii; lateral ix. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles paired in xi, xii. Prostates xviii within xvi-xxi, both glandular portions consist of two or three main lobes. Genital papillae of xviii with small stalked glands in two rows corresponding approximately in number to externally visible small spots; each gland with small lobes, non-muscular stalk.

Ovaries in xiii. Paired spermathecae vii, viii; each ampulla a broad slightly furrowed pouch; ducts short, diverticula with slender muscular stalk, chamber thin, coiling, as long as ampulla; no nephridia on spermathecal ducts.

Remarks: *A. yongshilensis* sp. n. and the next eight species, all of which have manicate intestinal cecum and spermathecal pores in 6/7 and 7/8, can be distinguished from the previous 11 species, which have simple intestinal caeca and spermathecal pores in 5/6 and 6/7. The present species appears to be closely related to *Amynthas alveolatus* sp. n., but is separated easily by the shape of the male pore region and genital papillae because segment xviii of *A. alveolatus* sp. n. is covered with genital papillae.

Amynthas alveolatus sp. n.

Figs 4D-F

Material: Holotype and 3 paratypes: Korea, Jeju-do, Sangumburi (33° 22'-23'N, 126° 47'E), 200-300 m, volcanic crater, soil and litter layers, 17 October 1996, Y. Hong, (KIBIO). Other material: Same data as for holotype, 8 acitellate; Jeju-do, Sangumburi, 23 clitellate, 5 acitellate, 200-300 m, litter layers, 14 August 1997.

Etymology: The specific epithet (Latin: *alveolatus*, meaning hive) refers to the conspicuous shape of the genital papillae.

Diagnosis: Spermathecal pores in 6/7, 7/8. Male pores near lateral margins of xviii, superficial on 0.3-0.5 mm diameter round-shaped; between male pores paired pre- and post-setal groups, each group containing 2-18 circular genital papillae. Genital markings lacking.

Description: Dimensions 74-103 mm by 4.8 mm at segment x, 4.6 mm at xxx, 5.2 mm at clitellum; body cylindrical throughout, segments 69-88. Setae regularly distributed around segmental equators, numbering 42 at vii, 45 at xx; 12-18 between male pores, spacing regular; setal formula AA:AB:YZ:ZZ = 3:2:2:3 at xiii. Female pore single in xiv, 1.0 mm round or oval shape and 0.4 mm pores. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible externally.

Male pores near lateral margins of ventrum in xviii, superficial on 0.3-0.5 mm diameter round-shaped porophore on setae line; porophore within thickened white area of 5-6 concentric furrows becoming narrower towards outer edge, some may extend into xvii, xix. Between furrowed areas surrounding male pores, paired pre- and post-setal groups, each group containing 2-18 small circular genital papillae. Paired spermathecal pores ventrally in 6/7, 7/8. No genital markings in spermathecal segments.

Septa 5/6, 6/7 thick, 7/8 thin with some muscle. 8/9, 9/10 absent, 10/11-13/14 thin. Gizzard globular in viii-ix. Intestine begins in xv, lymph glands from xv. Typhlosole very small from xxvi. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxiii, each consisting of one large, four small digitate divisions. Hearts esophageal x-xiii; ix lateral. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs from xi, xii extending into x. Prostates xviii extending to xvii-xx; short and thick ducts, glandular portions consist of two or three main lobes. Genital papillae of xviii with crowded overlapping small stalked glands corresponding approximately in number to the externally visible small papillae; glands mushroom shaped, stalks flattened, not muscular.

Ovaries in xiii. Paired spermathecae in vii and viii, viii flattened by gizzard, ampulla a rounded pouch with pebbly outer texture; ducts muscular, shorter than ampulla; diverticula with muscular slender stalk, kinked or coiled chamber, much shorter than ampulla; no nephridia on spermathecal ducts.

Remarks: Genital papillae numbers vary between the pre- and post-setal pairs of patches, and between members of the same pair. Some nematodes were found in the intestine, as was a long tree root fragment.

Amyntas geomunensis sp. n.

Figs 4G-L

Material: Holotype and 4 paratypes: Korea. Jeollanam-do. Wando-gun, Dongdo-ri, Geomun Isl. (34° 02'-03'N, 127° 21'E), 50-100 m. soil and litter layers in forest, 07 September 1996, Y. Hong. (KIBIO). Other material: Same data as for holotype, 15 clitellate specimens.

Etymology: The species is named after the type locality.

Diagnosis: Spermathecal pores in 6/7, 7/8. Male pores at tips of conical porophores surrounded by concentric furrows; centered between male pores pre-setal oval cluster of 7-22 small genital papillae. Pre-setal genital markings; diffuse diagonally cross-hatched zone equatorial between clusters of genital markings.

Description: Dimensions 106-158 mm by 5.8-7.0 mm at segment x, 6.0-7.5 mm at xxx, 5.8-7.5 mm at clitellum; body cylindrical throughout, segments 73-101.

Setae regularly distributed around segmental equators, numbering 55 at vii, 49 at xx; 6-21 between male pores, distance irregular; setal formula AA:AB:YZ:ZZ = 4:3:2:3 at xiii. Female pore single in xiv, 0.7 mm round pore field, 0.4 mm white pore. Prostomium epilobic, with tongue open. Brown dorsally and yellowish ventrally, clitellum brown, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores visible sometimes, externally.

Male field flattened; male pores at tips of conical porophores surrounded by concentric furrows; each porophore and surrounding furrowed area 1.2-1.8 mm diameter, some furrows inconspicuous. Centered between male pores pre-setal oval cluster of 7-22 small genital papillae, papillae 0.2 mm oval white spots with darker surround. Spermathecal pores ventral in 6/7, 7/8; clear oval pores in furrows. Pre-setal genital markings, 3-7 right side, 0-14 left side of vii, circular or oval shape, like genital papillae of xviii; also 3 at vi and 1 at xix, seen in one individual; diffuse diagonally cross-hatched zone equatorial between clusters of genital markings.

Septa 5/6, 6/7 thick, 7/8 thin, 8/9 very thin, 9/10 absent, 10/11-13/14 some muscle. Gizzard globular in viii-x. Esophagous with vertical lamellae xii, xiii. Intestine begins in xv, paired lymph glands on dorsal vessel from xvi. Typhlosole low ridge from xxvii. Intestinal cecum manicate, originating in xxvii, extending anteriorly about to xxiii, each consisting of one large, 5 smaller finger-shaped sacs. Hearts esophageal x-xiii, lateral ix, one side not developed. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi; sacs of x appear to be within 10/11, but mainly pre-septal. Seminal vesicles, two pairs in xi and xii, one pair 1.8 mm round lobes projecting from those of xii. Prostates xviii rather large within xvii-xxi; glandular portions consist of two or three main lobes, ducts short, thick, widening ectally. Genital papillae of xviii with small stalked glands corresponding approximately in number to the externally visible small spots; glands single or lobed, stalks simple or with 2 or more canals, no circular muscle layer.

Ovaries in xiii. Paired spermathecae at vii, viii; each ampulla reniform, pebble textured surface, ducts slightly shorter than ampulla, muscular, widening ectally; diverticula with slender stalk, digitate kinked chamber; overall as long as duct-ampulla axis. Genital marking glands near spermathecal ducts each side in vii, stalks short, otherwise similar to glands of xviii.

Remarks: The species is similar to *A. alveolatus* sp. n. and *A. yongshilensis* sp. n., with respect to genital papillae, but it differs in size and numbers of papillae. Genital papillae are centered between male pores, rather than in paired groups, but genital markings are paired in vii. There was some parasitism, probably gregarine cysts, and many nematodes in the body cavity.

Amyntas eastoni sp. n.

Figs 4M-Q

Material: Holotype and 3 paratypes: Korea, Gyung-sangnam-do, Hamyang-gun, Mt. Baekun (35° 37'N, 127° 38'E), 400-700 m, litter layers in forest, 07 August 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 10 clitellate; Jeollabuk-do, Jangsu-gun, Mt. Jangan, 600-850 m, litter layers, 1 clitellate, 8 aclitellate, 28 July 1998.

Etymology: Named for Mr. Edward G. Easton, who made many good contributions to systematics of earthworms.

Diagnosis: Spermathecal pores in 6/7, 7/8, oval area of different surface texture from 6/7, 7/8 posterior to each pore. Paired genital papillae xviii pre-setal at median edge of raised area, separate from male patches. Genital markings paired in vii, viii, pre-setal, median to spermathecal pores.

Description: Dimensions 78-120 mm by 5.0-5.5 mm at segment x, 5.0-6.6 mm at xxx, 5.2-6.1 mm at clitellum; body cylindrical throughout, segments 70-102. Setae regularly distributed around segmental equators, numbering 52 at vii, 64 at xx; 14-19 between male pores, size distance regular; setal formula AA:AB:YZ:ZZ = 4:2:3:4 at xiii. Female pore single in xiv, 1.0 mm oval shape and 0.5 mm round white pore. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores sometimes visible externally.

Male pores near lateral margins of ventrum in xviii, within invaginate male patches, sometimes accompanied by 2 or 3 small genital papillae; patches equatorial, 0.8 x 0.5 mm round or quadrilateral, within 2 x 1 mm elevated area. Paired genital papillae xviii pre-setal at median edge of raised area, small, clearly defined with white central pore, separate from male patches; one individual two genital papillae on each side. Spermathecal pores in 6/7, 7/8, oval area of different surface texture from 6/7, 7/8 posterior to each pore. Genital markings paired in vii and viii, pre-setal, median to spermathecal pores, superficial or slightly indented, dark circle with central white pore opening.

Septa 5/6, 6/7 thick, 7/8 thin with some muscle, 8/9, 9/10 absent, 10/11-12/13 thin. Gizzard largely globular in viii-x. Intestine begins xiv, lymph glands from about xxx, very small. Typhlosole small from xxvii. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxiv, each consisting of one large, 5 middle size finger-shaped sacs, the more ventral ones becoming gradually smaller. Esophageal hearts three pairs in xi-xiii, ix lateral, x absent. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles xi, xii. Prostates xviii extending to xvi-xxi; middle and thick ducts, both glandular portions consist of two or three main lobes. Genital papillae of xviii each with one stalked mushroom-shaped gland; stalk apparently composed of several non-muscular canals.

Ovaries in xiii. Paired spermathecae in vii, viii; ampulla large ovate, ducts short thick, diverticula with thin stalk, large sausage-shaped chamber, diverticulum length variable, longer or shorter than ampulla; no nephridia on spermathecal ducts. Genital marking glands in vii and viii, same structure as those of xviii but larger.

Remarks: The species is similar to *Amyntas boletiformis* sp. n., but it is distinguished by the shape of the male pore region and the genital markings. This species also has clear spermathecal patches. Genital papillae gland stalks are also different from those of *A. boletiformis* sp. n.

***Amyntas boletiformis* sp. n.**

Figs 5A-E

Material: Holotype and 2 paratypes: Korea, Jeollanam-do, Jangseong-gun, Mt. Baekam, Baekyang-sa (35° 26'N, 126° 53'E), 200-400 m, litter layers in forest, 29 June 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 5 clitellate, 2 acitellate;

Jeollanam-do, Jangseong-gun, Mt. Baekam, Baekyang-sa, 200-400 m, litter layers, 3 clitellate, 8 acitellate, 17 July 1998.

Etymology: The specific epithet *boletiformis* is Latin for mushroom, which refers to shape of the larger genital marking glands.

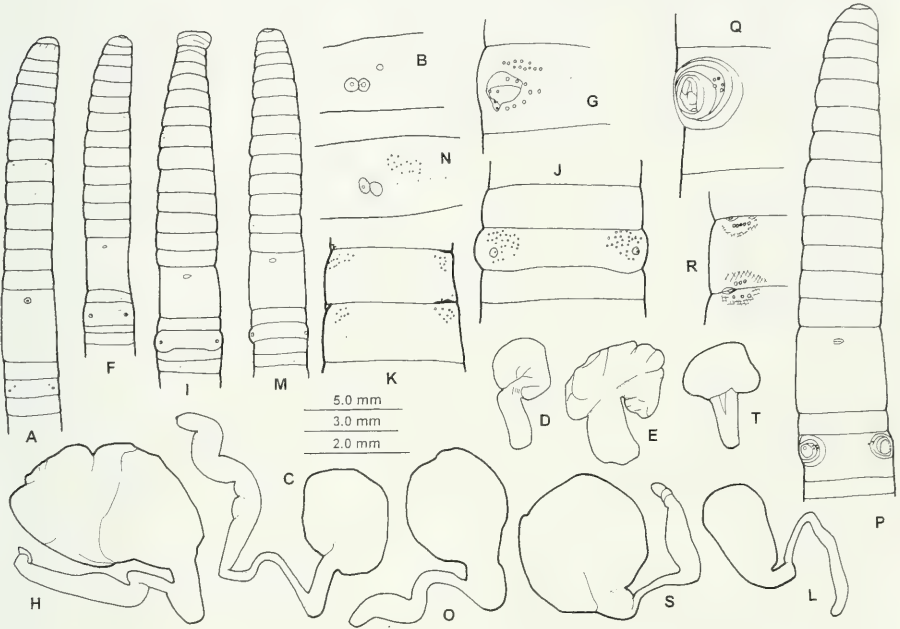


FIG. 5

A-E. *Amynthas boletiformis* sp. n. A: ventral view; B: male pore region in xviii; C: spermathecae; D: genital marking glands in viii; E: genital papillae glands in xviii. F-H. *Amynthas odaesanensis* sp. n. F: ventral view; G: male pore region in xviii; H: spermathecae. I-L. *Amynthas righii* sp. n. I: ventral view; J: male pore region in xviii; K: spermathecal pore region; L: spermathecae. M-O. *Amynthas fasciiformis* sp. n. M: ventral view; N: male pore region in xviii; O: spermathecae. P-T. *Amynthas sanchongensis* sp. n. P: ventral view; Q: male pore region; R: spermathecal pore region; S: spermathecae; T: genital marking glands in viii. Scales bars = 5 mm (A, F, I, J, K, L, M, P), 3 mm (Q, R, S), 2 mm (B, C, D, E, G, H, N, O, T).

Diagnosis: Spermathecal pores in 6/7, 7/8. Male pores lateral margins of xviii: invaginated on round area; paired equatorial papillae adjacent to male pore circle. Paired genital markings around dark spermathecal pore.

Description: Dimensions 61-86 mm by 3.5 mm at segment x, 3.9 mm at xxx, 4.1 mm at clitellum; body cylindrical throughout, segments 68-84. Setae regularly distributed around segmental equators, numbering 45 at vii, 42 at xx; 14-15 between male pores; setal formula AA:AB:YZ:ZZ = 3:2:1.5:3 at xiii. Female pore single in xiv, 0.4 mm round or oval shape and 0.1 mm white pores. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum coffee color.

formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores visible sometimes externally.

Male pores lateral margins of ventrum in xviii, superficial on segmental equator; slightly invaginated on 0.15 mm diameter round area with pore visible as black dot in small white spot; paired equatorial papillae adjacent to male pore circle; papillae 0.2 mm circles with central pore. Paired genital papillae, pre-setal xviii 0.1 mm round spot with pore. Paired spermathecal pores 6/7, 7/8 near margin ventrally, clear dark color with circumference. Paired genital markings 0.05-0.1 mm area around dark pore; paired in viii (8 individuals), in vii, viii (1 individuals), absent (1 individuals).

Septa 5/6, 6/7 thick, 7/8 slightly muscular, 8/9, 9/10 absent, 10/11-13/14 thin with some muscle. Gizzard globular in viii-x. Intestine begins xv, lymph glands small from xxvii. Typhlosole small from xxvii. Intestinal cecum manicate, originating in xxvii, extending anteriorly about to xxiv, each consisting of 5 finger-shaped lobes, the more ventral ones becoming gradually smaller. Hearts xi-xiii esophageal, ix lateral, x not found. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi; but x mainly within xi. Seminal vesicles, two pairs in xi and xii, less developed. Prostates xviii extending to xviii-xxi; ducts long, muscular, widening ectally, both glandular portions consist of three main lobes, each lobe divided into leaflets. Pre-setal genital papillae of xviii with large stalked mushroom shape glands, muscular stalk, small genital papillae next to male pores with short stalks, little or no glandular development.

Ovaries in xiii. Paired spermathecae in vii, viii; viii little larger than vii; each ampulla a small pouch, ducts thick, diverticula long and slender, much longer than ampulla; no nephridia on spermathecal ducts. Genital markings of vii, viii with single large stalked gland corresponding to each externally visible spot.

Remarks: The present species has two types of genital papillae, pre-setal and adjacent to male pore, with different gland types. This differentiation between genital papillae is unique among Korean *Amyntas*.

Amyntas odaesanensis sp. n.

Figs 5F-H

Material: Holotype and 3 paratypes: Korea, Gangwon-do, Pyeongchang-gun, Mt. Odae, Sangwon-sa (37° 46'-47'N, 128° 34'E), 800-1000 m, litter layers in forest, 11 July 1998, Y. Hong, (KIBIO).

Etymology: The species is named after the type locality.

Diagnosis: Spermathecal pores in 6/7, 7/8. Male field xviii composed of paired ovate to circular raised pads, each pad with short rows of 11-15 small genital papillae. Genital markings pre-setal paired sets of 5-8 in segments vii, viii.

Description: Dimensions 73-77 mm by 3.3 mm at segment x, 3.4 mm at xxx, 2.9 mm at clitellum; body cylindrical throughout, segments 81-84. Setae regularly distributed around segmental equators, numbering 60 at vii, 64 at xx; 13-15 between male pores, distance regular; setal formula AA:AB:YZ:ZZ = 2:1:2:3 at xiii. Female pore single in xiv, 0.4 mm oval shape. Prostomium epilobic, with tongue open.

Brownish dorsally and yellowish ventrally, clitellum with coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores visible, externally.

Male field xviii composed of paired ovate to circular raised pads, placed sublaterally; male pores within indentations of lateral halves of pads; each pad with short rows of 11-15 small genital papillae placed pre-setally, lateral ends of rows medial to male pores; V-shaped groups of small genital papillae surround medial anterior, posterior faces of male pore indentations, the apices medial; sometimes one or two genital papillae lateral to male pore indentations. Spermathecal pores 6/7, 7/8 ventrally, conspicuous. Genital markings pre-setal paired sets of 5-8 in segments vii, viii; placed medial-ventrally to spermathecal pores; genital markings regularly spaced in short lines within each set.

Septa 5/6, 6/7 thick, 7/8 thin, 8/9, 9/10 absent, 10/11, 11/12 thin, 12/13, 13/14 thin with some muscle. Gizzard small globular in ix-x. Intestine begins in xv, lymph glands very small from xxvii. Typhlosole very small from xxvii. Intestinal cecum manicate, originating in xxvii, extending anteriorly about to xxiv, each consisting of 5 finger-shaped sacs, more ventral ones becoming gradually smaller. Esophageal hearts three pairs in xi-xiii, ix lateral. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles, two pairs xi, xii. Prostates xviii large within xvii-xx; ducts short, thick, both glandular portions consist of three main lobes, each lobe divided into leaflets; one specimen had gland right side xvii-xxiii. Genital papillae of xviii with small stalked glands corresponding approximately in number to the externally visible markings, stalks very short giving appearance of single acinous mass surrounding prostatic duct.

Ovaries in xiii. Paired spermathecae in vii, viii; viii larger than vii, mitten shape ampulla half covered with pleats, ducts thick, short; diverticula with slender stalk, chamber with wide base tapering down towards end, as long as ampulla; no nephridia on spermathecal ducts. Genital marking glands vii, viii with longer stalks, otherwise like glands of xviii; corresponding in number to external markings.

Remarks: The species is similar to *Amyntas righii* sp. n., but it differs in genital papillae group shape, having the papillae in 2-3 irregular rows. Aclitellate specimens have the same size male pores, genital markings, and genital papillae as clitellate specimens. The only difference is the lack of a clitellum.

Amyntas righii sp. n.

Figs 5I-L

Material: Holotype and 3 paratypes: Korea, Jeollabuk-do, Jangsu-gun, Mt. Jangan (35° 37'N, 127° 36'E), 600-850 m, litter layers in forest, 28 July 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 15 clitellate, 2 aclitellate; Gyungangnam-do, Hamyang-gun, Mt. Baekun, 400-700 m, litter layers, 44 clitellate, 07 August 1998.

Etymology: Named for the late Dr. Gilberto Righi, Brazilian Oligochaetologist who died in 1999.

Diagnosis: Spermathecal pores in 6/7, 7/8; with cross-hatched oval zones surrounding pores. Male pores on oval pads, pads extend to 17/18, 18/19; genital papillae

within pads small, numerous 20-33 right, 18-33 left. Genital markings in vii, viii pre-setal, median to spermathecal pores.

Description: Dimensions 49-95 mm by 4.5 mm at segment x, 4.5 mm at xxx, 4.7 mm at clitellum; body cylindrical throughout, segments 57-96. Setae regularly distributed around segmental equators, numbering 49 at vii, 48 at xx; 16 between male pores, some regular distance; setal formula AA:AB:YZ:ZZ = 3:2:3:4 at xiii. Female pore single in xiv, 0.7 mm oval surround, 0.4 mm white pore. Prostomium epilobic, with tongue open. Light brownish dorsally and yellowish ventrally, clitellum coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae and dorsal pores invisible, externally.

Male pores on oval pads, pads extend to 17/18, 18/19; male pores on indented 0.3 mm round spots close to lateral edges of pads. Genital papillae within pads small, numerous 20-33 right, 18-33 left (two individuals had only 1-3 genital papillae with in each pad). Spermathecal pores in 6/7 and 7/8 near margin, minute, superficial but conspicuous with cross-hatched oval zones surrounding pores. Genital markings in vii, viii pre-setal, median to spermathecal pores; variable in numbers among individuals, sites; in wedge shaped or rhomboidal groups of 9-13 at vii; 9-15 at viii, rarely 1-3 in vi.

Septa 5/6 and 6/7 thick, 7/8 thin and some muscle, 8/9, 9/10 absent, 10/11-12/13 thin, 13/14 with some muscle. Gizzard small globular in viii-ix. Intestine begins xv, lymph glands very small from xxii. Typhlosole from xxxv. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxv, each consisting of 5-6 finger-shaped small lobes, becoming gradually smaller ventrally. Hearts xi-xiii esophageal, ix lateral, x not found. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi; sacs joined ventrally; x may be mainly in xi, hard to follow extremely thin septum 10/11. Seminal vesicles two pairs in xi, xii, well developed, with smooth-surfaced dorsal lobe. Prostates xviii within xvii-xx; short thick ducts, both glandular portions consist of two or three main lobes, each lobe divided into leaflets. Genital papillae of xviii with small stalked glands corresponding approximately in number to externally visible small spots.

Ovaries in xiii. Paired spermathecae in vii and viii; each ampulla a large berry-shaped pouch, thick short ducts drastically narrowed at body wall, ampulla flattened in viii by gizzard; conspicuous blood vessel and blood color on ampulla surface; diverticula longer than ampulla; slender stalk, larger tapered sausage shape chamber; no nephridia on spermathecal ducts. Genital marking glands paired groups in vii, viii, corresponding to external genital marking. All stalked glands of similar form; simple stalk without circular muscle, blocky to cordate glandular portion.

Remarks: The species is similar to *A. odaesanensis* sp. n., but it differs from it in the shape of the male pore region, the genital markings, the location of genital papillae within the male patches. The number of genital markings is greater than in *A. odaesanensis* sp. n., and they are more irregular in arrangement. A large leaf fragment was in the intestine, as were several nematodes. Gregarine cysts were found in some individuals.

Amynthas fasciiformis sp. n.

Figs 5M-O

Material: Holotype and 3 paratypes: Korea, Jeollabuk-do, Gochang-gun, Mt. Sonun (35° 31'-32'N, 126° 34'E), 50-300 m, soil and litter layers in forest, 02 July 1998, Y. Hong, (KIBIO). Other material: Same data as for holotype, 9 clitellate; Jeollanam-do, Jangseong-gun, Mt. Baekam, Baekyang-sa, 200-400 m, litter layers, 8 clitellate, 4 acitellate, 17 July 1998.

Etymology: This species is named for the bundles (Latin *fasciiformis*) of genital papillae glands.

Diagnosis: Spermathecal pores in 6/7, 7/8 at leading edges of vii and viii. Male pores near lateral margins of xviii; on superficial low porophore 0.3 mm diameter adjacent to small dark genital papillae. Genital markings paired groups of small spots vii, viii, median to spermathecal pores.

Description: Dimensions 62-87 mm by 4.4 mm at segment x, 4.3 mm at xxx, 4.5 mm at clitellum; body cylindrical throughout, segments 68-92. Setae regularly distributed around segmental equators, numbering 47 at vii, 48 at xx; 16-17 between male pores, size and distance regular; setal formula AA:AB:YZ:ZZ = 3:2:3:4 at xiii. Female pore single in xiv, 1.0 mm oval surround and 0.4 mm white pore. Prostomium epilobic, with tongue open. Light brownish dorsally and yellowish ventrally, clitellum with coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisible and dorsal pores visible, externally.

Male pores near lateral margins of ventrum in xviii; on superficial low porophore 0.3 mm diameter adjacent to small dark genital papillae 0.2 mm diameter. Male pore areas within elevated pad on which is one pre-setal pair of oval groups of very small densely placed genital papillae, 18-21 left, 16-25 right. Spermathecal pores small white spots within lenticular area 6/7, 7/8 at leading edges of vii, viii; near mid-lateral level. Genital markings paired groups of very small spots vii, viii; median to spermathecal pores, groups oval 0.4 mm, 9-13 markings per group vii, 10-13 viii.

Septa 5/6 and 6/7 thick, 7/8 thin, 8/9, 9/10 absent, 10/11 thin, 11/12- 12/13 thin with some muscle. Gizzard globular in viii-ix. Intestine begins in xv, lymph glands small from about xx. Esophagous with vertical lamellae xii, xiii. Typhlosole small from xxvii. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxiii, each consisting of 5 finger-shaped lobes, becoming gradually smaller ventrally. Esophageal hearts in x-xiii, ix lateral. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi; sacs of x about half with in level of xi. Seminal vesicles small, two pairs in xi, xii. Prostates xviii large within xvi-xx; medium length thick ducts, both glandular portions consist of three main lobes, with scattered dark pigmentation small clustered. Genital papillae of xviii with stalked glands corresponding approximately in number to the externally visible small spots; glands with circular muscle in stalks, glandular parts simple; genital papillae adjacent to male pores with sessile glands medial to prostate ducts.

Ovaries in xiii. Paired spermathecae in vii, viii, viii flattened; each ampulla a large pouch, ducts thick, short, with very narrow ectal end at right angle to main duct axis; diverticula with long cayenne pepper shape chamber, slender muscular stalk, together as long as ampulla; no nephridia on spermathecal ducts. Genital marking glands corresponding in number to the external markings in paired bundles vii, viii;

each gland with long stalks containing circular muscle, glandular parts white, ovate, smooth surface.

Remarks: This species is similar to *A. righii* sp. n., but easily distinguished by the pre-setal location of the genital papillae, the shape of male pore region and the location of genital markings; in *A. righii* sp. n. genital papillae and male patches are on the same site, as are spermathecal pores and genital markings. The papillae and markings are tightly clustered in *Amyntas fasciiformis* sp. n.

Amyntas sanchongensis sp. n.

Figs 5P-T

Material: Holotype and 3 paratypes: Korea, Gyung-sangnam-do, Sanchong-gun, Mt. Jiri (35° 22'-25'N, 127° 48'-49'E), 600-1200 m, litter layers in forest, 30 August 1997, Y. Hong, (KIBIO). Other material: Same data as for holotype, 12 clitellate; Jeollabuk-do, Namwon-gun, Mt. Jiri, Manbokdae, 1100-1400 m, litter layers, 16 clitellate, 31 August 1997.

Etymology: The species is named after the type locality.

Diagnosis: Spermathecal pores in 6/7, 7/8 deep in furrows flanked anteriorly, posteriorly by tumid lips. Male pores on large conical porophores markedly protuberant at lateral margins of xviii; apex of porophores with lateral crescentic groove. Genital markings near 6/7, 7/8.

Description: Dimensions 88-121 mm by 5.2-6.5 mm at segment x, 6.0-7.1 mm at xxx, 5.8-6.8 mm at clitellum; body cylindrical throughout, segments 78-95. Setae regularly distributed around segmental equators, numbering 53 at vii, 48 at xx; 14-18 between male pores; setal formula AA:AB:YZ:ZZ = 2:2:3:5 at xiii. Female pore single in xiv, 0.8 mm oval surround and 0.1 mm pore. Prostomium epilobic, with tongue open. Brownish dorsally and yellowish ventrally, clitellum dark coffee color, formalin preservation. First dorsal pore 12/13. Clitellum annular xiv-xvi; setae invisable externally.

Male pores on large conical porophores markedly protuberant at lateral margins of ventrum in xviii; apex of porophores with lateral crescentic groove; male pore at center of arc medial to groove. Upper medial faces of porophores with 4-5 small pre-setal genital papillae; which number 5 right side, 4 left side, or lacking in eight of sixteen individuals. Spermathecal pores 6/7, 7/8 deep in furrows flanked anteriorly, posteriorly by tumid lips; each lip bearing 1-3 small genital markings, or lacking in 8 of 16. Genital markings also near 6/7, 7/8; 3-6 at 6/7 and 4-5 at 7/8 right side; 3-5 at 6/7 and 4-5 at 7/8 left side, lacking in eight of sixteen individuals.

Septa 5/6, 6/7 thick, 7/8 slightly muscular, 8/9, 9/10 absent, 10/11-12/13 slightly muscular. Gizzard moderate size in viii-x. Intestine begins xv, lymph glands small from about xxvii. Esophagous with vertical lamellae xi-xiii. Typhlosole very small from xxvii. Intestinal cecum manicate, originating in xxvii, and extending anteriorly about to xxiii, each consisting of 5-6 finger-shaped lobes. Esophageal hearts x-xiii, ix lateral. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles middle size two pairs xi, xii, well developed. Prostates xviii large within xvi-xxi; duct, long, looped; ectal portion thick; both glandular portions consist of four main lobes, each lobe divided into leaflets. Genital

papillae of xviii with small stalked glands corresponding approximately in number to externally visible small spots; glandular part simple or lobed, stalks without circular muscle.

Ovaries in xiii. Paired spermathecae vii, viii; viii larger than vii; each ampulla a large lenticular pouch, may be flattened by gizzard, short thick ducts with right angle bend to very narrow ectal portion, diverticula slender cayenne pepper shape covered with small pigment spots; stalk slender, diverticula shorter than ampulla; no nephridia on spermathecal ducts. Genital marking glands of vii, viii same numbers as genital markings, glands white simple stalks, not muscular.

Remarks: The present species appears to be related to *Amyntas jiriensis* (Song & Paik, 1971), but it differs in the shape of male pore region and the genital markings. The specimens are smaller than *A. jiriensis*, and have less well-defined spermathecal patches. The species was collected from two sites in Mt. Jiri. Manbokdae specimens are smaller than Sanchong specimens, and the former are from higher altitude.

DISCUSSION

Spermathecal patches may be clearly defined as in *A. jiriensis*, otherwise there can be furrowed areas which might be spermathecal patches, but there is no distinct difference between these and moderately furrowed epidermis. Therefore, accurate diagnosis is difficult. Spermathecal or genital patches are distinctive regions around spermathecal pores. These are found in *A. vicinus* sp. n., *A. oviformis* sp. n., *A. deogyusanensis* sp. n., *A. cuneatus* sp. n., *A. seungpanensis*, and *A. plantus*. In these species there are no genital markings in the spermathecal segments. In *A. vicinus* sp. n. and *A. seungpanensis* the patches are connected, but in *A. oviformis* sp. n., *A. deogyusanensis* sp. n., *A. cuneatus* sp. n., and *A. plantus* the patches are separated by setae. There may be developmental stage differences in the extent of patches, or these differences may be characteristic of the species.

Locations, shapes, and numbers of genital markings are variable, and are important characters for species recognition. All are located on the ventral side, but they may be paired either singly or in groups, or centered on the mid-ventral line. Recall that according to the conventions adopted in this study that genital markings are those located in the segments including and anterior to the clitellum. Four species found in Korea with genital markings have them centered: *A. geomunensis* sp. n., *Amyntas hilgendorfi* (Michaelsen, 1892), *Amyntas carnosus* (Goto & Hatai, 1899), *Amyntas heteropodas* (Goto & Hatai, 1898).

Genital markings are usually round, much like the genital papillae of the male pore region. In *A. geomunensis* sp. n., the genital markings are protuberant but genital papillae are invaginate. Sizes of markings range from very small in *A. odaesanensis* sp. n. to much larger in *A. geomunensis* sp. n. Genital marking glands correspond approximately in number to the external visible markings, and they are of two types, stalked with obvious external pore, and sessile without obvious pore on the external surface of the earthworm. Although location, shape and numbers of genital marking are often variable within species, there are consistent differences between species.

making them very useful external characters for classification in *Amyntas* group. However, the function and development of genital markings need more study.

The characteristics of the male pore area are very useful for classification of *Amyntas* and have been used throughout the history of the genus. Male pores of most Korean *Amyntas* are on xviii, but *Amyntas megalolidioides* (Goto & Hatai, 1899) has them on xix, with one pair of genital papillae at xviii. Male pores are lacking in three species: *Amyntas irregularis* (Goto & Hatai, 1899), *Amyntas levis* (Goto & Hatai, 1899), *Amyntas shinkeiensis* (Kobayashi, 1938) and irregularly present or absent in four species: *Amyntas koreanus* (Kobayashi, 1938), *Amyntas vittatus* (Goto & Hatai, 1898), *A. hilgendorfi*, and *A. agrestis*. There are both male-sterile and hermaphroditic morphs of *Amyntas diffringens* (Baird, 1869). The variability can be severe, extending to the spermathecal pores in *A. koreanus*. Individuals with no male pores also lack prostate glands.

Most Korean *Amyntas* have superficial male pores. There are some with slightly invaginated male pores, but none is invaginated to the extent of forming copulatory pouches as in *Pheretima* and *Metaphire*. The invagination is more a depression or sunken zone with male pores still visible externally, and therefore the male pores are still superficial. The superficial male pores can be on a simple porophore, or as in those species with male discs, the pore is associated with large, hardened swellings that may enlarge the ventral area of xviii. These discs often have additional thickened areas around their circumference. The male disc species do not have genital papillae glands, and some disc bearing species have seminal grooves within the disc. Species with this condition are: *A. piagolensis* sp. n., *A. eastoni* sp. n., *A. boletiformis* sp. n., *A. koreanus*, *A. kobayashii*, and *A. sopaikensis*, (Song & Paik, 1973). In *Metaphire* there are developmental stages of the male pore invagination (Easton, 1979), so this possibility needs to be studied in the Korean *Amyntas*.

Most species have setae between male pores but *A. vicinus* sp. n., *A. jindoensis* sp. n., *A. seungpanensis*, and *A. plantus* do not. More material should be examined to see if this difference is consistent within species, and if it is phylogenetically informative. These four species have male field structures similar to the discs of some other Korean *Amyntas*, but here they are accompanied by distinct bands anterior and posterior to the male pads.

When the male pores are present, the genital papillae are always found. The papillae are similar to the genital markings near spermathecal pores, but are not always of the same form as genital markings. In most species, the genital papillae and genital patches have the same appearance. Numbers, size, shape, and locations are variable, and these papillae are useful characters for recognizing species.

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